City of Roanoke Stormwater Utility
Roanoke River & Tributaries Bacteria Monitoring Program
FY2022 MS4 Annual Report

Background:

Fecal bacteria are the leading cause for Virginia water bodies to be placed on the USEPA's 303(d) Impaired Water List. As a point of fact, the Roanoke River and 11 of its tributaries having watersheds within City limits are part of over 10,000 miles of river and streams across the Commonwealth that have been designated as Impaired for not meeting Recreational Water Quality Standards for bacteria. Streams designated as Impaired go through a Total Maximum Daily Load (TMDL) process so that clean-up plans can be developed to address the various sources of fecal bacteria including: livestock, pets, wildlife, and humans. As part of the City's Sediment and Bacteria TMDL Action Plan, a Bacteria Monitoring Program was developed to accomplish the following:

- To detect average levels of bacteria in the Roanoke River and tributary streams
- To determine locations of any potential bacterial "hotspots"
- To track identified "hotspots" upstream to their source

Methods:

Staff uses the Level III IDEXX® Colilert method. The Virginia Department of Environmental Quality (DEQ) recognizes the Colilert method as a Level III method. Level III methods and associated data can be used by DEQ as if the DEQ collected and processed the samples. Staff collects samples at 41 sites on the Roanoke River and its tributaries the third week of every month, resulting in at least 492 samples collected annually. Additional samples are taken as needed during wet weather or to track bacteria sources upstream. Secondary field observations and measurements are also collected such as: rainfall, dissolved oxygen, pH, conductivity, water color, odor, and general observations. All data is collected via a staff-created iPad App and stored in the City's ArcGIS online database.

Updates in FY 2022:

1. In FY 2021, Stormwater staff suspended human marker sampling due to COVID-19's impact on sampling availability. In late FY2022, human marker sampling with HRSD was resumed and will continue into FY2023.

2. In FY 2021, Stormwater staff tested high frequency sampling in 3 watersheds (Tinker Creek, Roanoke River, and Murray Run) at 6 sites (Bennington, Ivy St., Wasena, Mason Mill Park, 24th St., and Fishburn Park) for 12 weeks, from June 15th 2021 to September 1st 2021. High frequency sampling will continue as needed and regular monthly sampling will continue for long term data collection.

While the monitoring data is collected for TMDL purposes and to conduct source tracking as required under the City's MS4 Permit, the data could also be used to advise citizens of the health of popular recreational streams. As potential bacteria sources are identified, the Stormwater staff may also work with local community partners including WVWA and Clean Valley Council to facilitate solutions through various remediation efforts. One such example is supporting the WVWA in securing DEQ 319(h) grant funds to construct infrastructure where failing septic systems have been identified and no sanitary sewer connections exist. A sanitary sewer line was recently installed in the 2800-3000 block of Richard Avenue, and WVWA is working with residents in that area to connect to that line. To date, 14 septic systems have been abandoned with connections made to the public sewer. Three more properties in the City of Roanoke have been approved and are waiting on plumbers to do on-site work. We expect these projects to be connected in Fall 2022.

Monitoring Data to Date:

Since there are many variables that affect the bacteria levels of the Roanoke River and its tributaries including: temperature, wildlife, sunlight, nutrients, turbidity, as well as nearby septic systems, potential sanitary sewer overflows, or illicit connections, it is premature to provide in-depth analysis of the data collected to date. There are, however, observable seasonal variances, with higher bacteria in summer and fall and lower bacteria in winter, as well as higher bacteria after rainfall events. Over time the program will establish a baseline of data to help prioritize source tracking and other remediation efforts. As the program continues to evolve, sampling sites are added or adjusted based on new data in order to locate bacteria sources. Stormwater continues to review data to determine if some sites need to be added, changed or removed based on the current data as well as the potential to be better used as a location for human marker sampling. One site was adjusted in FY2022 for better access, moving slightly downstream (TKR 01.75 13th St is now inactive and TKR 01.54 Baldwin Ave is now active). Some site descriptions were adjusted due to changes in the site surroundings or access points.

To date, the streams with the highest recurring bacteria loads are Lick Run, Mud Lick, Peters Creek, Horton Branch, Trout Run and Murray Run. The Recreational Water Quality Standard set by the DEQ for E. coli is, in a period of 90 days, recording a geometric mean of 126 CFU/100 ml (colony forming units/ 100 milliliters) or less *and* a statistical threshold of 410 CFU/100ml (not to be exceeded more than 10% of the time).

The bar graph below shows the median indicator bacteria levels for the past two years of the bacteria monitoring program. The x-axis includes the sampled streams with the total number of samples taken in brackets after the stream name. The number of sampling sites varies per watershed based on percentage of the watershed within the City's jurisdictional boundaries, access, and other risk factors. The y-axis represents the average fecal indicator bacteria (E. coli) levels and includes the red dashed-line depicting the statistical value threshold of at 410 CFUs/100ml. While the bar graph illustrates the median or average bacteria levels, the vertical black dimension lines represent the percentage of bacteria levels above and below the 25% (bottom) and 75% (top) quartile. Since current sampling practices do not fit the new standard of a 90 day sampling window, the below map simply shows the range of sample scores, over the course of the calendar year, in relation to the statistical threshold value, one part of the updated DEQ Recreational Water Quality Standard.

Figure 1: Bar Graph showing levels of indicator bacteria in sampled streams.

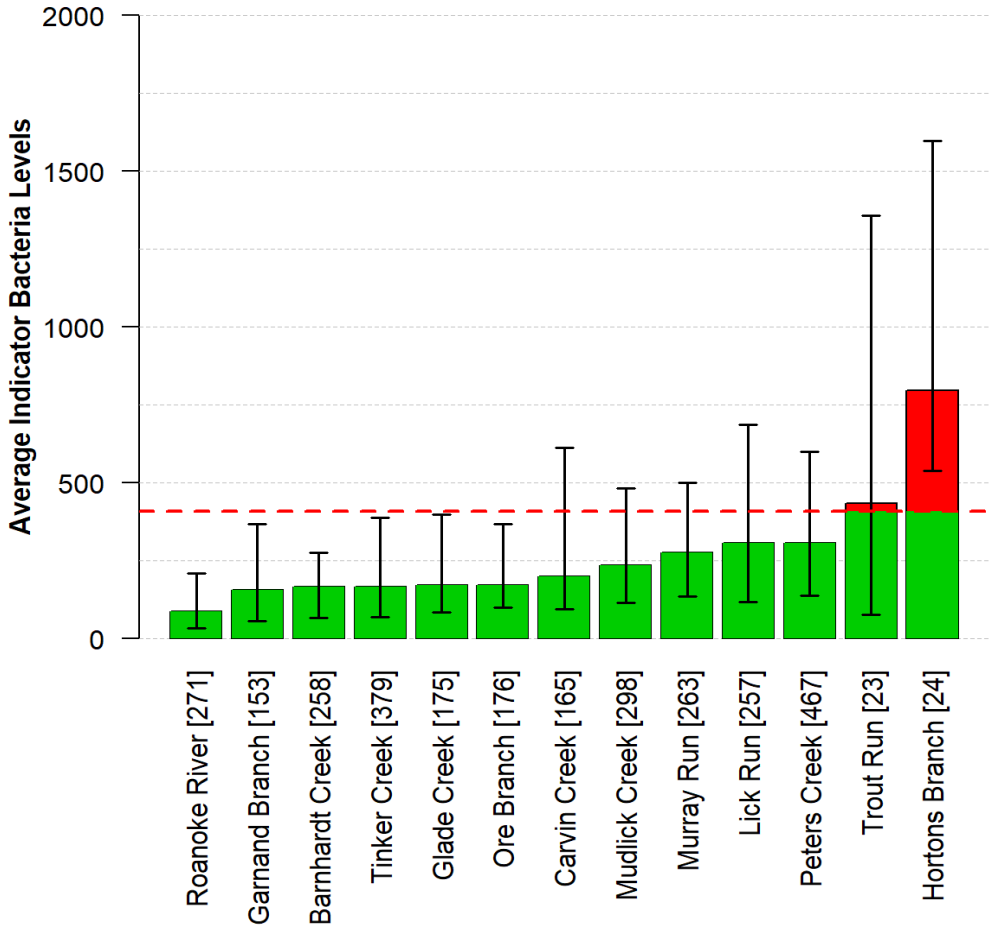
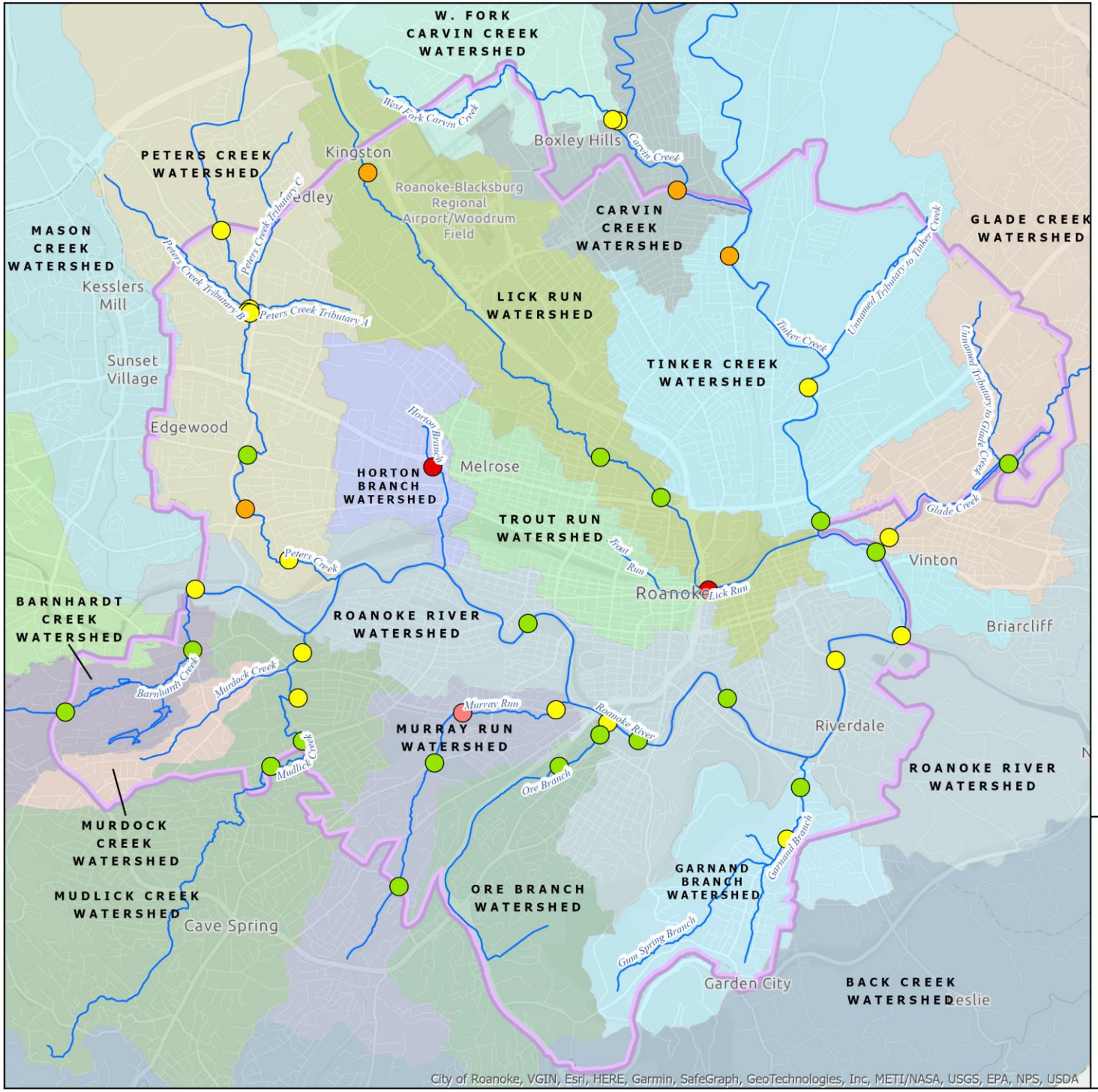


Figure 2: City of Roanoke Watershed Map

The map below shows the subwatersheds or tributary watersheds to the Roanoke River. Each dot represents the exact monitoring locations on the streams where water samples are taken each month. The legend shows the color spectrum which represents the percentage of bacteria samples at that location that were above 410 CFUs/100ml. Since current sampling practices do not fit the new standard of a 90 day sampling window, the below map simply gives an approximation of the relationship of samples taken to the statistical threshold value, part of the DEQ Recreational Water Quality Standard.



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Miles

ROANOKE STORMWATER

Monthly Monitoring
April 2017-July 2022

Bacteria Sites

Percent Exceedance

- ≤25%
- ≤40%
- ≤50%
- ≤75%
- ≤100%